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ABSTRACT

This publication of the National Science Foundation contains information about various programs related to the development of mathematics curriculum and materials; course materials for elementary and secondary mathematics programs; and, materials for both preservice and inservice teacher education in mathematics. (FL)

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NATIONAL SCIENCE FOUNDATION

# Curriculum Activities in Mathematics for Elementary and Secondary Schools

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## General

**Cambridge Conference on School Mathematics.** William Ted Martin, Department of Mathematics, Massachusetts Institute of Technology, Cambridge, Mass. 02139

This project has carried on intensive study and discussion among mathematicians and scientists on long-range goals in the teaching of mathematics in the schools, on the mathematics education of teachers, and on correlated science and mathematics curricula.

Further information and experimental materials are available from:

Education Development Center, Inc., 55 Chapel St., Newton, Mass. 02160 or ERIC.

Published materials:

Reports on major conferences and recommendations:

Houghton Mifflin Co., 2 Park St., Boston, Mass. 02107

**Survey of Recent East European Literature in School and College Mathematics.** Izaak Wirszup, Department of Mathematics, The University of Chicago, Chicago, Ill. 60637

The Survey is translating and adapting materials from East European sources, particularly the Soviet Union, for use by teachers and students as supplements to the formal curriculum in schools and colleges and in teacher education programs.

Listing of titles and publishers is available from the project director.

**Conference on Computer-Assisted Instruction.** Ralph T. Heimer, Department of Education, Pennsylvania State University, University Park, Pa. 16802

This conference, sponsored jointly the Pennsylvania State University and the Committee on Programmed Instruction of the National Council of Teachers of Mathematics, was designed to inform mathematics educators about the present status of computer-assisted instruction and its prospects for the next several years.

A report of the conference is available through:

The National Council of Teachers of Mathematics,  
1201 16th St., Washington, D.C. 20036

# Curriculum Projects

## Elementary and Secondary School

**School Mathematics Study Group (SMSG).** E. G. Begle, 10 Cedar Hall, Stanford University, Stanford, Calif. 94305

SMSG has prepared sample text materials for grades 1 through 12 designed to illustrate the kinds of curricula which the Study Group feels are demanded by the increased use of science, technology, and mathematics in our society, and materials designed to help teachers prepare themselves to teach such a curriculum. Extensive classroom trials have been conducted. A second major activity of the SMSG is the National Longitudinal Study of Mathematical Abilities in which students originally in grades 4, 7, and 10 are being followed to determine the effects of conventional, SMSG, and other new course sequences on performance in mathematics and science in school and college. This study has been extended to the lower primary level in order to provide a sound basis of factual knowledge for further reform in mathematics in the early grades. Special tests for measuring mathematics achievement have been developed to evaluate higher cognitive skills. This study has also been concerned with such variables as socio-economic status and the timing and placement of exposure to mathematical concepts.

Further information and experimental materials are available from SMSG.

### Published materials:

Texts and teachers' commentaries:

A. C. Vroman, Inc., 367 South Pasadena Ave., Pasadena, Calif. 91105

New Mathematical Library:

Random House, Inc., 239 Great Neck Rd., Great Neck, N.Y. 11021

The L. W. Singer Company, Inc., 501 Madison Ave., N.Y. 10022

School and Library Services, 457 Madison Ave., N.Y. 10022

Teacher training films:

Modern Learning Aids, 1212 Avenue of the Americas, New York, N.Y. 10036

## Elementary School

**Experimental Teaching of Mathematics in the Elementary School.** Patrick Suppes, Institute of Mathematical Studies in the Social Sciences, Stanford, Calif. 94305

Project effort is devoted to the development of a computer-based laboratory for the experimental teaching of elementary-school mathematics. Computer programs have been developed for a complete curriculum for grades 1 and 2, a supplementary course in mathematical logic for upper elementary school, and drill and practice materials supplementing arithmetic instruction for grades 1 through 6.

Further information and project documentation are available from the project director.

### Published materials:

Academic Press, 111 Fifth Ave., New York, N.Y. 10003

**Minnesota School Mathematics and Science Teaching Project (MINNEMAST).** James H. Werntz, Jr., Minnesota School Mathematics and Science Center, University of Minnesota, Minneapolis, Minn. 55455

The main purpose of the project was to produce a coordinated mathematics and science curriculum for lower elementary school, with appropriate teacher-training materials. A Cartesian coordinate system and graphical algorithms for numerical operations provided the main focus for the mathematics materials. The science materials centered about operations a scientist does (observing, describing, classifying, measuring, forming hypotheses, testing). Later science materials include the study of invariance and change under different physical transformations in physical and biological systems. The materials are prepared for average elementary-school children with supplementary enrichment activities for gifted children.

Minnemast Center quarterly reports are available from the project director.

**Madison Mathematics Project.** Syracuse University-Webster College, Robert B. Davis, Department of Mathematics, Syracuse University, Syracuse, N.Y. 13210

Intervention at the level of actual school experience rather than at the textbook or curriculum level is the Madison Project approach. Present emphasis is on grades 1-9, and subject emphasis is a combination of arithmetic, axiomatic algebra, coordinate geometry, rudimentary study of functions, logic, limit of a sequence, and some physics. Major products include films and written materials for in-service education of teachers, and curriculum units for children.

Newsletters and in-service series are available from the project director.

**Improvement Project in Mathematics for Subcultural Groups.** E. Glenadine Gibb, Science Education Center, University of Texas, Austin, Tex. 78712

This project is an attempt to adapt to local needs, improved mathematics curricula developed on a national basis. The project hopes to demonstrate that, through local adaptation of existing curriculum materials, desired levels of mathematical understanding and use of mathematics can be effectively developed for all children consonant with their abilities and needs and with the vital aims of a modern mathematics program.

Further information and experimental materials are available from the project director.

## **Secondary School**

**University of Illinois Committee on School Mathematics (UICSM).** Max Beberman, University of Illinois Committee on School Mathematics, 1210 West Springfield, Urbana, Ill. 61801

UICSM has developed two two-year sequences. The first is a presentation of the arithmetic of rational numbers and of intuitive motion geometry for underachieving junior high school students; the second, a vector geometry course for senior high school.

### **Published materials:**

Junior high school sequence:

Harper & Row, 49 East 33rd St., New York, N.Y. 10016

Vector geometry course:

The Macmillan Co., 60 Fifth Ave., New York, N.Y. 10011

Teacher training films:

Modern Learning Aids, 1212 Avenue of the Americas, New York, N.Y. 10036

**Evaluation of Secondary School Mathematics Curricula.** James J. Ryan, Director of Research, Minnesota National Laboratory, State Department of Education, 1821 University Ave., St. Paul, Minn. 55104

The evaluation, conducted with experimental classes in Minnesota, Wisconsin, Iowa, and the Dakotas, concerns a comparison of the conventional, School Mathematics Study Group, Ball State, Illinois, and Maryland curricula. The effectiveness of curricula under various conditions of use and qualifications of staff was evaluated.

Bulletins and reports are available from the Minnesota National Laboratory.

**Computer Training and Use in Secondary Schools.** Thomas E. Kurtz, Kiewit Computation Center, Dartmouth College, Hanover, N.H. 03755

The purpose of this project was to demonstrate the use of the computer as an aid to secondary education. Some twenty public and private secondary schools were linked to the Dartmouth Time-Sharing System, using the simple computer language BASIC. Dissemination of the project's experience and of the materials developed is encouraging other institutions to expand their use of computers as a general education aid.

Further information is available from the project director.

**Use of Mathematics in Science Teaching.** John A. Easley, Jr., Department of Education, University of Illinois, Urbana, Ill. 61801

The project studied ways of improving science teaching at secondary school levels through more appropriate uses of elementary mathematics. Sample materials were developed on the uses of mathematics for science teachers. Points at which mathematics can be used more appropriately and effectively were identified and new or improved mathematical treatments of scientific topics were explored.

Final report is available from the project director.

**Mathematics Curriculum Improvement Study.** Howard F. Fehr, Teachers College, Columbia University, New York, N.Y. 10027

Building on an integrated junior high school sequence developed earlier, detailed curricula for grades 10 through 12 will be constructed which eliminate traditional barriers separating the several branches of mathematics and which emphasize the subject's general concepts and structures. Major constructs such as sets, relations, and mappings of functions will be used to unify mathematics and build the fundamental structures of algebra (group, ring, field) and their realizations in the number systems.

Further information and sample curriculum materials are available from the project director.

**A Ninth Grade Mathematics Course.** Max Beberman, University of Illinois Committee on School Mathematics, 1210 West Springfield, Urbana, Ill. 61801

This course will be an alternative to both the conventional ninth grade algebra course and the conventional general mathematics course offered by schools today, and it will have a scope appropriate to students of varying interests and talents. Units will cover three major areas: coordinates and functions, probability and statistics, and mensurational solid geometry.

Further information is available from: Mr. Russel E. Zwoyer, UICSM, 1210 West Springfield, Urbana, Ill. 61801



**High School Course in Modern Coordinate Geometry.** Robert A. Rosenbaum, Academic Vice President, Wesleyan University, Middletown, Conn. 06457

The distinctive feature of this tenth-year geometry course is the development of affine geometry before Eucliden, using coordinates at the outset.

**Published materials:**

Text and teachers' commentary:

Houghton Mifflin Co., 2 Park St., Boston, Mass. 02107

**Preparation of Materials for Pre-Limit Calculus.** Haim Reingold, Department of Mathematics, Illinois Institute of Technology, Chicago, Ill. 66016

A new approach for teaching calculus in the last year of high school includes a development of the theory of maxima and minima, of rate problems, and of applications of calculus to geometric questions. Area and volume problems are treated as applications of the integral calculus.

Further information is available from the project director.

### **Advanced Secondary School**

**Committee on the Undergraduate Program in Mathematics (CUPM)** George B. Pedrick (Executive Director), Committee on the Undergraduate Program in Mathematics, Box 1024, Berkeley, Calif. 94701

The Committee on the Undergraduate Program in Mathematics is concerned with the system consisting of the undergraduate curriculum in mathematics, the students and their teachers, the purposes of the program, its achievements and shortcomings, and the facilities for undergraduate mathematics. The principal work is partitioned into four areas: (1) pre-service training of elementary and secondary school teachers and the improved recruitment and pre-service training of college mathematics teachers; (2) mathematics for students of engineering and the physical sciences; (3) mathematics for the biological, management, and social sciences; and (4) pre-graduate education of potential research mathematicians. Detailed curricula and course syllabi have been designed for each of the above areas.

Further information and materials are available from the executive director.

**Power Series and the Elementary Functions.** Howard Levi, Herbert H. Lehman College (CUNY), New York, N.Y. 10021

A one-semester course in elementary functions based on the systematic use of power series was developed. The course is suitable for college freshmen and may serve as a terminal course in calculus.

**Published materials:**

Text:

D. Van Nostrand Co., Princeton, N.J. 08540

**Geometric and Graphic Aids for College Calculus.** Gorman R. Nelson, Department of Mathematics, School of Engineering, South Dakota State University, Brookings, S.D. 57006

Sequences of color slides have been developed to supplement conventional chalk board sketches in conveying the fundamental concepts in calculus. Audio tapes and written materials were produced to increase the flexibility and utility of the slide sequences. The materials can be used by the lecturer during his presentation and as review and self-teaching tools by students.

Further information is available from the project director.

**Experimental Undergraduate Instruction in Computing.** John G. Kemeny, Department of Mathematics, and Thomas E. Kurtz, Computation Center, Dartmouth College, Hanover, N.H. 03755

The Dartmouth Computation Center was developed as a flexible teaching device for students in all fields. Students electing a year of freshman mathematics are being taught the fundamentals of programming in the BASIC language and the use of input-output stations to the Time-Sharing System.

The project has produced several kinds of materials: (1) the user's manual for the BASIC language; (2) a description and block diagram of the principal components of the Time-Sharing System, particularly the BASIC compiler; (3) a number of short monographs containing illustrative computer problems to be used in connection with a variety of mathematics, physics, and engineering courses.

**Published materials:**

Manual and supplements:

Dartmouth Publications, Dartmouth College, Hanover, N.H. 03755

**Implementation of Innovative Mathematics Course Using an Auxiliary Undergraduate Computing Facility.** Judah Rosenblatt, Department of Mathematics, Case Western Reserve University, Cleveland, Ohio 44106

Case Western Reserve University has modified its two-year sequence in calculus so that both freshmen and sophomores are using a large digital computer as a tool in developing their comprehension of mathematics. The computer serves as an aid in comprehending certain topics; and students entering advanced courses are equipped with a basic understanding of computer techniques which may be valuable in solving problems that are a regular part of the curriculum. The procedures developed at Case are being documented and evaluated, and results of the work will be published.

Further information is available from the project director.

**Development of a Computer-Related Calculus Sequence.** Guenter Schwarz, Director, Center for Research in College Instruction of Science and Mathematics, Florida State University, Tallahassee, Fla. 32304

The project developed and is testing a basic undergraduate calculus sequence involving computer-related topics and methods. To increase the usefulness of the course on campuses with widely divergent computing systems, the materials have been prepared so as to be as nearly machine-independent as possible.

Further information and sample materials are available from the project director.

**Introductory Course on Probability Matrices and Calculus for Students in the Biological and Social Sciences.** G. Baley Price, Department of Mathematics, the University of Kansas, Lawrence, Kans. 66045

Materials suitable for a two-semester course in probability, matrices, and calculus have been prepared. One volume contains chapters on systems of linear equations, matrices and algebraic systems, elementary set theory, counting problems, and probability with applications to problems in accounting, business, economics, acceptance sampling, genetics, and sociology. The second volume contains an elementary treatment of differential and integral calculus in a setting of probability theory and applications to the biological, management, and social sciences. Emphasis in calculus will be on concepts and their applications rather than on technique.

**Published materials:**

*Linear Equations and Matrices* (Johnson, Price, & Van Vleck)

*Sets, Functions, and Probability* (Johnston, Price, Van Vleck)

Addison-Wesley Publishing Co., Reading, Mass. 01867



# Preparation of Teachers

## Pre-service (Elementary)

**Course in the Number System for Elementary School Teachers.** Ralph Crouch, Department of Mathematical Sciences, New Mexico State University, University Park, N.Mex. 88076, and George Baldwin, Department of Mathematics, Eastern New Mexico University, Portales, N.Mex. 88130

A text for future elementary teachers has been designed to be used in two sequential, three semester-hour courses. The courses involve a study of the number system used in elementary school; emphasis is on basic concepts and techniques.

**Published materials:**

*An Intuitive Development of the Real Number System and Related Topics*

Department of Mathematics, New Mexico State University, University Park, N.Mex. 88130

**Mathematics Courses for Prospective Elementary School Teachers.** John R. Mayor and Helen L. Garstens, Department of Mathematics, University of Maryland, College Park, Md. 20742

Sample text materials in mathematics were prepared for pre-service courses for elementary teachers. Two sequential semester courses have been prepared, the first concerned with the structure of the number systems of ordinary arithmetic, and the second concerned with geometry, especially those concepts basic to the study of measurement. Deductive procedures are stressed.

**Published materials:**

**Texts:**

University of Maryland Mathematics Project, College of Education, College Park, Md. 20742

## Pre-service (Secondary)

**Course in Mathematics for Prospective Junior High School Teachers.** J. Maurice Kingston, Department of Mathematics, University of Washington, Seattle, Wash. 98105

The course materials include a discussion of the manner in which the concepts of arithmetic are generalized in the study of algebra with emphasis on the basic pattern and structure of the number system of arithmetic and its expansion to the real number system.

**Published materials:**

**Text:**

John Wiley and Sons, Inc., 605 Third Ave., New York, N.Y. 10016

**Course in Applications of Mathematics for Secondary School Teachers.** Gail S. Young, Department of Mathematics, Tulane University, New Orleans, La. 70118

A sourcebook of applications of mathematics in such areas as physical science, engineering, business, social science, medicine, computing, and linguistics has been prepared for present and prospective high school teachers. The format is a one-semester course with sufficient material to allow choice of topics according to the interests of class and teacher.

Further information is available from the project director.

**Experimental Teaching Program in Algebra.** Robert J. Walker, Department of Mathematics, Cornell University, Ithaca, N.Y. 14850

Curricula for three one-term courses have been developed: Basic Concepts of Mathematics; Linear Algebra; and Number Theory. The courses are designed primarily for future high school teachers. The goal is for students to have a thorough grasp of the fundamental concepts of modern abstract algebra and their relevance for other fields of study.

Further information is available from the project director.

**Geometry Course for Prospective High School Mathematics Teachers.** Seymour Schuster, Minnesota School of Mathematics and Science Center, University of Minnesota, Minneapolis, Minn. 55455

Materials for a college geometry course for the training of prospective high school teachers have been developed with emphasis on visual media and programmed instruction. The content includes material recommended in Course Guides for the Training of Teachers of Junior High and High School Mathematics, published by the Committee on the Undergraduate Program in Mathematics of the Mathematical Association of America.

Information on films and written materials is available from the project director.

**Project on Logic and Proof.** Max Beberman, University of Illinois Committee on the Study of Mathematics, University of Illinois, Urbana, Ill. 61801

The needs of prospective secondary school teachers of mathematics and of advanced undergraduates in mathematics lacking adequate training in the formulation of mathematical proofs stimulated the development of this project. Paragraph proofs are the focus of the course development effort and the textual materials will use a "guided discovery" approach.

Further information is available from the project director.

**Films and Other Teaching Materials for College Mathematics.** A. B. Wilcox, Executive Director, Mathematical Association of America, 1225 Connecticut Avenue, N.W., Washington, D.C. 20036

This project investigated the production, use, and evaluation of new media--films, television, programmed learning, etc., in mathematical instruction at the college level. Films and written materials are suitable for pre-service training of prospective mathematics high school teachers.

**Published materials:**

**Texts:**

W. A. Benjamin, Inc., 1 Park Avenue, New York, N.Y. 10016

**Films:**

Modern Learning Aids, 1212 Avenue of the Americas, New York, N.Y. 10036

### **In-service (Elementary)**

**University of Illinois Arithmetic Project.** David A. Page, Education Development Center, Inc., 55 Chapel St., Newton, Mass. 02158

Course materials in mathematics and its teaching are being prepared for elementary school teachers. Mathematical topics or schemes which offer interrelated problems that children can do, which contain significant mathematical ideas, and which will improve computational skills are incorporated in a course for teachers designed for in-service use. Materials include demonstration films, extensive problem sequences and written home work for teachers, and an instructor's correction and discussion guide comprising a semester course of 30 lessons.

**Published materials:**

Films and written materials:  
Education Development Center

**Foundations of Mathematics for Elementary School Teachers.** E. Glenadine Gibb, Science Education Center, The University of Texas, Austin, Tex. 78712

Twelve 30-minute films and accompanying text provide an introduction and orientation program for improving the mathematics training of elementary school teachers.

**Published materials:**

Films:  
Director of Field Service, State College of Iowa, Cedar Falls, Iowa 50613

**The Mathematics Aids Program.** Alvin N. Feldzamen, Encyclopedia Britanica, 425 N. Michigan St., Chicago, Ill. 60611

Pilot programs have been produced for an experiment in televised in-service education in mathematics for elementary school teachers. The programs, also aimed at a general audience, take up the properties of the number systems of arithmetic and new ways of teaching elementary algorithms in a lively and entertaining format.

Further information is available from Channel 13, Education Broadcasting Corporation, 304 W. 58th St., New York, N.Y. 10019, or from the project director.

**In-Service Films in Mathematics for Elementary Teachers.** Harry D. Ruderman, Department of Mathematics, Hunter College High School, 930 Lexington Ave., New York, N.Y. 10020

A series of 10 mathematics films (16 mm, color, 30 minutes each) has been produced for use in in-service training of elementary teachers. Each film is accompanied by text materials and a teachers manual for the whole series. The content of the course is the development of the whole number system, the operations in it and their properties, our common decimal system of numeration, and the usual algorithms.

**Published materials:**

Films:  
Universal Education and Visual Arts, 221 Park Ave. South, New York, N.Y. 10003

**University of Illinois Committee on School Mathematics (UICSM): Films for Training Ninth-Grade Algebra Teachers.** Max Beberman, University of Illinois Committee on School Mathematics, 1210 West Springfield, Urbana, Ill. 61801

UICSM has prepared a series of 50 films intended to acquaint teachers with the content of modern secondary school algebra courses and to exemplify pedagogical techniques which have proven effective with such content. The films have been produced for flexible use in pre-service, in-service, or institute training employing either the whole series or selected subseries. Extensive written materials accompany the films.

**Published materials:**

**Films:**

Modern Learning Aids, 1212 Avenue of the Americas, New York, N.Y. 10036

**In-service (Secondary)**

**Programmed Correspondence Courses in Algebra and Geometry for In-Service Training of Secondary School Mathematics Teachers.** Wells Hively II, Department of Educational Psychology, University of Minnesota, Minneapolis, Minn. 55414

Courses in algebra and geometry were developed to provide in-service teachers with the foundations needed to teach the newer secondary school curricula. The courses are programmed for self-instruction and designed to be self-contained. Each is approximately equal to a three credit quarter-hour course (about 100 hours of work).

Further information is available from the Minnesota Academy of Science, 3100 38th Ave. South, Minneapolis, Minn. 55406

**Published materials:**

*A Programmed Course in Algebra* (Ancel C. Newborn)  
Addison-Wesley Publishing Co., Reading, Mass. 01867